REPORT OF THE METEOROLOGICAL STATION AT BERKELEY, CAL., FOR THE YEAR ENDING JUNE 30, 1914.[1]

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[*Author's abstract* submitted May 24, 1916.]

The meteorological record kept at Berkeley by the University of California in cooperation with the Weather Bureau dates from October 16, 1886, without a break. In conformity with the practice adopted when the first five-year synopsis was published in 1892, that portion of the record before July 1, 1887, has been rejected; this practice permits the published record to conform to the administrative year of the university, which is also the most convenient annual unit for the study of the meteorological phenomena at Berkeley, specially the precipitation which is under subtropical control, having winter cyclonic rains, forming a rainy season beginning in the fall and continuing to the next spring. This rainfall régime makes it almost necessary to separate the annual units at some time during the dry summer rather than at the beginning of the calendar year. The work was carried on under the direction of the Department of Geography during the year ending June 30, 1914. This is the second report under the present direction.[2]

No new equipment was added and no changes in the routine of the station were made during the year. The observations, made at 8 a. m. and 8 p. m., Pacific time, have been as follows:

1. Temperature of the air (dry-bulb thermometer).
2. Temperature of evaporation (wet-bulb thermometer).
3. Maximum temperature in the preceding 12 hours.
4. Minimum temperature in the preceding 12 hours.
5. Pressure of the air.
6. Amount of cloud and weather.
7. Wind direction and estimated velocity.
8. Precipitation in the preceding 12 hours.

In addition to the observation of measurable phenomena at the regular hours of observation, a record has been kept of the general character of each day and the prevailing wind direction from casual observations during the day, of the times of beginning and ending of precipitation, of the occurrence and character of fog and of frost. An attempt has also been made to record miscellaneous and occasional phenomena of interest, although such a record must of necessity be incomplete in the absence of more frequent observations than is usually practicable at the university. The autographic records of air temperature and pressure and of relative humidity are complete for the year; the instrumental errors are small in the cases of all the instruments in service. Terrestrial radiation temperatures were obtained on most of the clear nights during the winter months from several places on the campus; these furnish the first data for the study of the distribution of frost on the campus. This work is, however, largely experimental in character. For each month in which the tipping-bucket gage was in operation maximum rainfall rates have been furnished by the Department of Civil Engineering.

The instruments are all located on the campus of the University of California. The campus is situated on the inner or eastern edge of the coastal plain which forms the eastern shore of San Francisco Bay. The distance from the water's edge to the instruments is about 4 kilometers (2½ miles), and the elevation of this part of the campus is about 95 meters (310 feet). The slope is gentle and nearly uniform from the campus to San Francisco Bay, but immediately east of the campus the Berkeley Hills rise to elevations of over 300 meters (1,000 feet) in less than 2 kilometers (1¼ miles). The Golden Gate is about 20 kilometers (12 miles) west-southwest from the station, and the Pacific Ocean is about 2 kilometers farther westward.

In addition to the routine work of the station, the following studies have received attention:

1. Frost conditions in Berkeley.
2. Temperature comparison between the university campus and the Berkeley High School building.
3. Hydrographic survey of Strawberry Creek.

The first of these studies has been carried on during the year by the writer is a more or less casual manner, although the observations are accumulating for future use. The second is the result of the cooperation of the Berkeley High School with the Department of Geography of the university. The hydrographic survey was carried on during the year as thesis work in the College of Civil Engineering, although the writer assisted in the meteorological aspects of the problem.[3]

A monthly and annual summary of the meteorological record kept at Berkeley during the year ending June 30, 1914, is presented in Table 1. This table includes the same elements as are published for the regular stations of the Weather Bureau in the annual report of the chief, with the exception of automatic wind records, which are not available for Berkeley.

The use of the C. G. S. system of rational meteorological units has been continued for the reasons stated in the previous report.[4]

Table 1 shows the meteorological conditions of the year in a general manner. In Table 2 the extreme temperatures for each month have been compiled from the 27-year record.

In California rainfall data are without doubt the most important of climatic records. Table 3 shows the monthly and accumulated seasonal precipitation and its relation to the average of the whole record for each month of the year 1913–14.

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[1] *Author's abstract* of University of California, Publications in Geography, v. 1, No. 9, pp. 373–439, pls. 45–55, 10 text figs., issued Apr. 10, 1916.

[2] An abstract of the report for 1912–13 was published in the MONTHLY WEATHER REVIEW, Apr., 1914, 42: 164–166.

[3] *See* MONTHLY WEATHER REVIEW, January, 1915, 43: 35–39.

[4] The meteorological units used in this report are defined as follows:

Bar, a pressure equal to an accelerating force of 1 megadyne (1,000,000 dynes) per square centimeter.

Millibar, a pressure equal to one-thousandth of a bar—that is, 1 kilodyne (1,000 dynes) per square centimeter.

Dyne, a force which acting for one second will impart to a mass of 1 gram a velocity of one centimeter per second.

Absolute temperature, the number of degrees above "absolute zero" in units whose length is one one-hundredth of the difference between the boiling point of pure water and the melting point of pure ice under standard conditions. In this system the melting point of ice is 273°A.

Tables for the use of the C. G. S. units and conversions to and from English units may be found in the Smithsonian meteorological tables and this REVIEW, April, 1914, 42: 281.

TABLE 1.—*Meteorological summary, Berkeley, Cal., for the year ending June 30, 1914.*

[H=100.6 m; H_b=98.0 m; h_t=1.5 m; h_s=4.6 m; ϕ=37° 52′ N.; λ=122° 16′ W. 120th meridian time.]

Month.	Pressure (sealevel equivalents.)			Temperature.							Moisture.									
		Extremes.		Mean.					Extremes.		Dew point.		Relative humidity.		Vapor pressure.		Precipitation.		Cloudiness.	
	Monthly mean (corrected for diurnal variation).	Maximum.	Minimum.	8 a. m.	8 p. m.	Maximum.	Minimum.	Monthly.	Maximum.	Minimum.	8 a. m.	8 p. m.	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Total.	Maximum in 24 hours.	8 a. m.	8 p. m.
	mb.	*mb.*	*mb.*	*°A.*	*°A.*	*°A.*	*°A.*	*°A.*	*°A.*	*°A.*	*°A.*	*°A.*	%	%	*mb.*	*mb.*	*mm.*	*mm.*	*0–10*	*0–10*
July	1016.0	1021.0	1006.7	288.7	288.3	296.1	285.1	290.6	308	282	285	285	81	82	14.2	14.0	4.8	2.5	5	4
August	1015.2	1021.3	1007.4	289.3	288.9	296.9	286.1	291.5	306	284	286	286	82	86	15.2	15.2	0.8	0.8	6	4
September	1015.6	1020.6	996.6	289.6	289.2	298.7	285.9	292.3	314	283	285	285	76	77	13.9	13.8	.....	.....	5	3
October	1016.7	1024.0	1005.7	286.6	287.3	296.7	283.6	290.2	308	280	281	282	75	72	11.1	11.3	9.1	9.1	4	3
November	1017.6	1027.1	992.2	283.3	284.4	288.9	281.8	285.4	297	277	281	282	93	88	11.3	11.8	149.4	35.6	7	5
December	1019.2	1027.1	1007.8	280.2	281.7	286.4	278.9	282.6	292	275	279	281	92	91	9.4	10.0	177.3	40.1	6	5
January	1017.8	1033.8	998.9	281.2	282.3	286.7	279.5	283.1	293	275	280	281	95	96	10.2	14.1	323.6	57.9	6	5
February	1019.5	1031.1	996.6	281.2	282.2	289.4	279.7	284.6	294	276	280	281	89	85	9.8	10.9	101.1	45.5	3	4
March	1018.9	1028.4	1007.1	284.5	285.5	293.2	282.2	287.7	304	276	282	282	82	82	10.8	11.7	25.2	23.9	5	4
April	1017.8	1025.0	1003.3	286.2	285.3	292.8	282.2	287.5	303	280	283	283	82	87	12.3	12.3	33.8	14.7	6	5
May	1016.1	1022.0	1010.5	285.7	285.2	291.8	283.8	287.3	297	280	284	284	92	93	13.0	13.0	15.8	5.3	6	6
June	1015.0	1020.6	1006.4	286.5	285.8	292.8	282.7	287.8	303	280	284	284	88	91	13.5	13.4	12.2	8.4	7	5
Year	1017.2	1033.8	992.2	285.2	285.5	292.5	282.6	287.6	314	275	282	283	86	86	12.1	12.6	853.1	57.9	6	4

Month.	Wind.									Number of days.											
	Prevailing direction.	Number of winds, 8 a. m. and 8 p. m.								Clear.	Partly cloudy.	Cloudy.	Precipitation.		Snow.		Hail.	Dense fog.	Maximum temperature.		Minimum temperature 273°A. or below.	Electricity.	
		North.	Northeast.	East.	Southeast.	South.	Southwest.	West.	Northwest.	Calm.				0.2 mm. and over.	1.0 mm. and over.	Trace or more.	0.2 or more melted.			273°A. or below.	303°A. or above.		Thunder-storm.	Aurora.
July	SW.	0	0	0	0	24	18	5	6	9	14	7	10	2	2	0	0	0	3	0	2	0	0	0
August	S.; SW.	1	0	0	3	33	3	10	1	11	13	12	6	1	0	0	0	0	2	0	1	0	0	0
September	NW.	5	0	0	0	12	10	12	3	18	13	13	4	0	0	0	0	0	2	0	0	0	0	0
October	SW.	4	3	3	3	19	9	5	2	14	15	10	6	1	1	0	0	0	6	0	0	0	0	0
November	S.	13	2	0	10	19	5	3	2	6	7	10	13	17	12	0	0	0	7	0	0	0	0	0
December	S.	3	4	4	8	28	3	0	3	10	7	8	16	13	12	0	0	0	1	0	0	0	0	0
January	S.	2	0	0	3	40	5	0	0	12	10	3	18	16	15	0	0	1	1	0	0	0	2	0
February	SW.	3	0	2	12	17	3	2	2	15	12	6	10	8	6	0	0	0	2	0	0	0	1	0
March	SW.	3	3	1	7	23	4	2	3	15	16	5	10	3	1	0	0	1	1	0	0	0	0	0
April	S.	6	0	0	3	26	7	2	4	12	12	10	8	7	7	0	0	0	1	0	0	0	0	0
May	SW.	0	0	0	8	18	20	4	4	8	13	8	10	6	5	0	0	• 1	1	0	0	0	1	0
June	SW.	1	0	0	11	19	14	6	3	6	10	13	7	4	3	0	0	0	2	0	1	0	0	0
Year	SW.	41	12	10	68	277	101	51	34	136	142	105	118	78	64	0	0	3	29	0	4	0	4	0

NOTE.—H=altitude of station (rim of raingage) above sealevel.

TABLE 2.—*Extreme temperatures July 1, 1887, to June 30, 1914.*

Month.	Maximum.		Date.	Minimum.		Date.
	°A.	*°F.*		*°A.*	*°F.*	
July	309.3	97.3	7, 1905	278.7	42.3	29, 1899
August	307.1	93.4	22, 1891	281.0	46.4	31, 1905
September	313.8	105.5	16, 1914	280.7	45.9	28, 1905
October	308.2	95.4	1, 1914	277.1	39.3	18, 1905
November	300.8	82.0	16, 1895	273.6	33.0	28, 1905
December	293.9	69.6	24, 1901	272.4	31.0	24, 1905
January	298.0	77.0	26, 1899	269.1	24.9	14, 1888
February	299.4	79.5	18, 1899	271.4	29.2	12, 1905
March	303.6	87.1	17, 18, 1914	274.1	33.9	30, 1905
April	303.3	86.6	24, 1913	275.2	36.0	19, 1896
May	306.6	92.5	26, 1896	277.4	39.9	1, 1899
June	311.4	101.1	6, 1903	278.8	42.4	2, 1903
Year	313.8	105.5	Sept. 16, 1914.	269.1	24.9	Jan. 14, 1888.

TABLE 3.—*Monthly and seasonal precipitation for 1913–14, with averages for 27 years and departures from the averages.*

Month.	Monthly.		Seasonal to end of month.		Average seasonal.		Departure, 1913–14.	
1913.	*Mm.*	*In.*	*Mm.*	*In.*	*Mm.*	*In.*	*Mm.*	*In.*
July	4.8	0.19	4.8	0.19	0.6	0.03	+ 4.2	+ 0.16
August	0.8	0.03	5.6	0.22	1.6	0.07	+ 4.0	+ 0.15
September	.....	.....	5.6	0.22	16.3	0.65	− 10.7	− 0.43
October	9.1	0.36	14.7	0.58	52.0	2.06	− 37.3	− 1.48
November	149.4	5.88	164.1	6.46	120.8	4.77	+ 43.3	+ 1.69
December	177.3	6.98	341.4	13.44	227.6	8.98	+ 113.8	+ 4.46
1914.								
January	323.6	12.74	665.0	26.18	379.7	14.97	+285.3	+11.21
February	101.1	3.98	766.1	30.16	481.6	18.98	+284.5	+11.18
March	25.2	0.99	791.3	31.15	600.7	23.67	+190.6	+ 7.48
April	33.8	1.33	825.1	32.48	637.5	25.12	+187.6	+ 7.36
May	15.8	0.62	840.9	33.10	666.0	26.24	+174.1	+ 6.86
June	12.2	0.48	853.1	33.58	671.6	26.46	+181.5	+ 7.12
1913–14. Season.	853.1	33.58	853.1	33.58	671.6	26.46	+181.5	+ 7.12

In spite of the difficulties encountered in treating rainfall by cyclones, the importance of such treatment is so great that it is essential for a complete presentation of the climatic data of an extratropical station. The number of cyclones with precipitation at Berkeley which was recognized during the year was 34. Cyclonic rainfall occurred in all months of the year except September. Of the total 853.1 millimeters of precipitation recorded, 850 millimeters has been assigned to particular cyclones. Of the remaining 3.1 millimeters 0.8 millimeter was probably dew. Besides this there was 2.3 millimeters which is, perhaps, of cyclonic origin, although neither the weather maps nor the barograph give evidence of cyclonic conditions.

The average rainfall per cyclone during the year was 16.2 millimeters; the heaviest precipitation in a single cyclone was 120.2 millimeters. In one other cyclone the precipitation approached this amount. The smallest amount of precipitation in any cyclone was 0.3 millimeter, but traces of rain were observed twice with cyclonic cloud, although the barograph trace and weather maps did not clearly show cyclones. The average daily precipitation during the passage of cyclones varied from a maximum of 26.2 millimeters on January 21–22 to a minimum of 0.3 millimeter on May 13–16 and June 24. The total number of days on which cyclonic conditions prevailed was 114, which makes the average amount of precipitation per day of cyclonic control 7.5 millimeters.

The duration of the cyclones was as varied as the rainfall. Subject to possible errors in the separation of cyclones when one closely follows another, the maximum duration of a single cyclone at Berkeley was seven days. The minimum duration of a cyclone with significant precipitation was 12 hours.

A problem closely connected with cyclonic weather control is that of rainfall by rainy days. In figure 1 the rainfall for the year has been presented by rainfall days; the rainfall day at Berkeley is the 24 hours ending at 8 p. m., Pacific standard time.

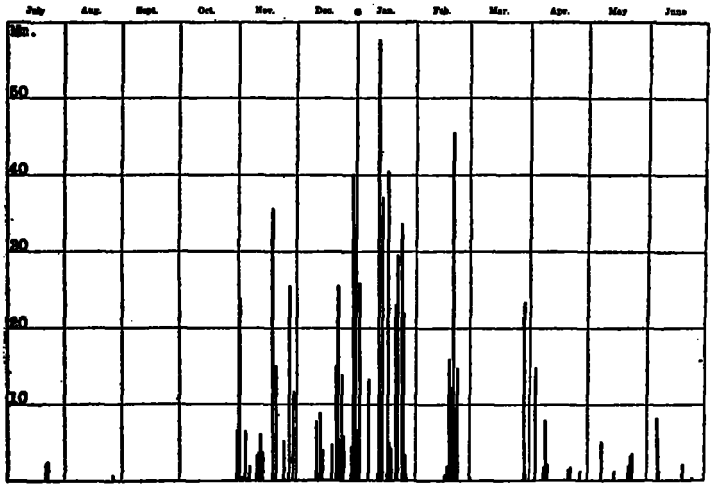

FIG. 1.—Daily precipitation at Berkeley, Cal., 1913–1914.

Figure 1 emphasizes the fact that even during the so-called rainy season the majority of the days are without rain. Although the year was more than usually rainy, only about half the days in the rainy months of November, December, and January had precipitation of 0.2 millimeter, or more; in the other months of the rainy season the proportion of rainy days was even less. The occurrence of rain in periods of several successive days followed by periods without rain, shows very clearly the cyclonic character of the rainfall. The occurrence of the greater part of the rain in the winter months is also shown by figure 1, as is the comparatively dry summer. Noticeable also for the year 1913–14 is the rainless period from August 28 to October 30 and the nearly rainless March. Another feature of the rainfall of Berkeley, which is shown more clearly by figure 1 than in any other way, is the occurrence of light rains during April, May, and June.

The mean annual temperature at Berkeley for 1913–14 was about 288°A., 58°F., with a mean annual range of 10°A., 17°F., and an extreme range of nearly 40° A., 70°F. The mean maximum temperature was 292°A., 67°F, and the mean minimum 283°A., 49°F. The mean monthly range was 22°A., 40°F., the mean daily range 10°A., 18°F. September was the warmest month of the year and December the coldest; no month had a very unusual temperature except March, which was in many respects a characteristic summer month. Frosts occurred from November to March.

The pressure of the water vapor of the atmosphere was in general less than 15 millibars, 11.2 millimeters, or 0.42 inch of mercury; the relative humidity averaged 86 per cent morning and night, the mean dewpoint was about 280°A., 44°F., in the winter and about 285°A., 54°F., in the summer months. The vapor pressure and the dewpoint showed a strong tendency to vary with the air temperature. Nearly 40 per cent of the days were generally clear and nearly 30 per cent generally cloudy; many of the partly cloudy days, specially in summer, had several hours of bright sunshine. Fog was observed on 29 days and the velo cloud, "high fog," on about as many more; this is not abnormal for Berkeley.

The total precipitation for the year was 853.1 millimeters, 33.58 inches, which is 181.5 millimeters, 7.12 inches, more than the average. September, October, March, and May had less than the average rainfall for these months; August, February, and April had about the average amount, and the other months had more than the average of the 27 years of record. The precipitation of January was among the heaviest monthly rainfalls ever recorded at Berkeley. Thunderstorms were observed on four dates; on three days hail fell. There were 78 days with significant precipitation, 0.2 millimeter or more, which is more than the average. In six months of the year there were more than the average number of rainy days for these months, and in six there were less than the average number. The heaviest fall of rain in a single day was 57.9 millimeters, 2.28 inches, on January 12; this is the only day on which as much as 50 millimeters, 2 inches, fell. The precipitation of the year was mainly the result of 34 cyclones, the barometric centers of most of which passed far north of Berkeley, although the cyclones were the controlling factors in the precipitation here; in many other cases the weather control was distinctly cyclonic.

The wind was generally from southerly and southwesterly directions during the year. This is true both for prevailing winds and for the direction at the observation hours. The westerly element was more marked in the summer months. Calm days were rare, four during the year, but at more than one-third of the observation hours no air movement was recorded.